AD-A139 017 SURVEY OF AUTOMATED STATEWIDE NATURAL RESOURCE INFORMATION SYSTEMS(U) ARMY ENGINEER WATERWAYS EXPERIMENT STATION VICKSBURG MS ENVIRONMENTAL LAB

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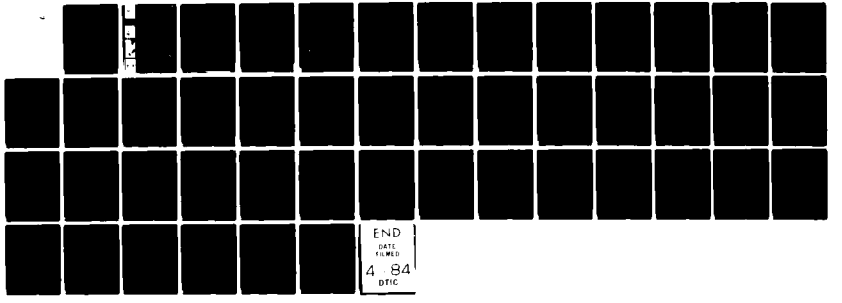

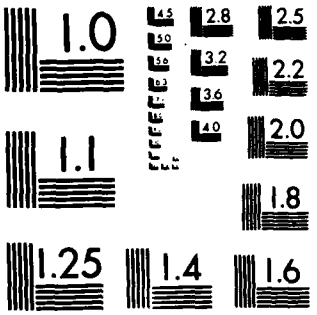

US Army Corps of Engineers

MISCELLANEOUS PAPER EL-84-1

SURVEY OF AUTOMATED STATEWIDE NATURAL RESOURCE INFORMATION SYSTEMS

by

E. May Causey

Environmental Laboratory
U. S. Army Engineer Waterways Experiment Station
P. O. Box 631, Vicksburg, Miss. 39180

January 1984
Final Report

Prepared for Office, Chief of Engineers, U. S. Army
Washington, D. C. 20314

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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER Miscellaneous Paper EL-84-1	2. GOVT ACCESSION NO. AD-A139017	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) SURVEY OF AUTOMATED STATEWIDE NATURAL RESOURCE INFORMATION SYSTEMS		5. TYPE OF REPORT & PERIOD COVERED Final report
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) E. May Causey		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS U. S. Army Engineer Waterways Experiment Station Environmental Laboratory P. O. Box 631, Vicksburg, Miss. 39180		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS Office, Chief of Engineers, U. S. Army Washington, D. C. 20314		12. REPORT DATE January 1984
		13. NUMBER OF PAGES 43
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

Available from National Technical Information Service, 5285 Port Royal Road, Springfield, Va. 22161.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Computer applications
Data collection systems
Geography
Information retrieval
Natural resources

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report contains the results of a survey to determine which states maintain a geographically referenced computer-based natural resource information system (NRIS). Twenty-two states currently have an NRIS in varying stages of development. A brief description of each system is included in Appendix A of this report.

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PREFACE

This study was performed for the Planning Division of the Office, Chief of Engineers (OCE), Washington, D. C. The objectives and scope of the study were coordinated with Dr. J. Belshe, Chief, Environmental Resources Branch, Planning Division, OCE.

The study was completed in July 1983 by Ms. E. M. Causey, Environmental Laboratory (EL), U. S. Army Engineer Waterways Experiment Station (WES), under the direct supervision of Mr. J. K. Stoll, Chief, Environmental Analysis Group, and the general supervision of Mr. B. O. Benn, Chief, Environmental Systems Division, and Dr. John Harrison, Chief, EL.

COL Tilford C. Creel, CE, served as Commander and Director of WES and Mr. F. R. Brown was Technical Director during the study and preparation of this report.

CONTENTS

SURVEY OF AUTOMATED STATEWIDE NATURAL RESOURCE INFORMATION SYSTEMS

PART I: INTRODUCTION

Background

1. Natural resource information systems (NRIS) have evolved over the past 15 years as a result of environmental legislation in the mid-1960's and throughout the 1970's and the rapid development of new techniques in automated data processing.

2. With the increased emphasis placed on conserving and effectively managing the nation's natural resources, policy makers require more and better data on which to base their decisions. Manual techniques for handling these data are slow and limited in analytical capabilities, while automated systems can store and analyze many kinds of data simultaneously.

3. The earliest NRIS, which were developed in the mid-1960's, were New York's Land Use and Natural Resource Inventory (1966) and Minnesota's Land Management Information System (1967). The current Texas NRIS evolved from the Texas Water Development Board's Water Oriented Data Program, which was created in 1968.

4. Environmental and natural resource data are used extensively in studies conducted by the U. S. Army Corps of Engineers Districts. Personnel of the U. S. Army Engineer Waterways Experiment Station have had a considerable amount of experience in developing and using software packages to evaluate and process geographically referenced data. Traditionally, the states have not been the source of such data.

Objective

5. The primary objective of this project was to determine which states maintain a central computer-based NRIS in which geographically referenced data can be input, manipulated, and analyzed; to identify the types of data in each system; to determine the availability of data to outside users; and to determine if any Corps Divisions/Districts are using the systems. A secondary objective was to provide information on existing database systems of potential

benefit to water resource project planning studies conducted by Corps Districts.

Approach

6. Available information pertaining to state natural resource databases was reviewed and a questionnaire was formulated. The questionnaire was used in a telephone survey of states. Documentation on the database systems was received from 19 states. These materials, extensive in some cases, are available at the WES and were used as resource materials for developing brief descriptions of each system. The results of the survey are summarized in this report.

PART II: STATUS OF STATEWIDE NATURAL RESOURCE INFORMATION SYSTEMS

Past Surveys

7. The development and status of state NRIS have been documented by several individuals during recent years. Based on information gathered in 1979, Mead (1981) determined that 32 states had a functioning NRIS or were developing such a system. Tessar and Caron (1980) prepared a guide to NRIS for the National Conference of State Legislatures. This survey listed 21 states with systems in varying stages of development. Cornwell (1981), reporting on the history and status of NRIS, listed 19 states with a functional system. In addition, the Kansas Applied Remote Sensing Program at the University of Kansas was recently awarded a grant to survey computer-based NRIS and databases throughout the United States. Results of this survey should be available by mid-1983.

8. The U. S. Army Engineer Waterways Experiment Station (WES) recently completed a survey to determine which states have a statewide natural resource database (Table 1) and which U. S. Army Engineer Divisions/Districts have requested data from the various systems (Table 2).

Summary of WES Survey

9. The WES survey established that 22 states have statewide NRIS in varying stages of development. The Alaska, Michigan, and Utah databases do not yet have statewide data. Data are entered into the Alaska Geoprocessing System on a project basis. Base map data in the Michigan Resource Inventory Program are being added to the system by counties, and data for approximately 30 percent of the state have been entered thus far. The Utah Automated Geographic Reference System has been used primarily for demonstration and training purposes since its installation, although statewide topography and public land survey data should be input to the system by the end of 1984.

10. The Arizona, Louisiana, Mississippi, and Virginia systems are in the early stages of development; however, these systems contain limited statewide data.

11. Hardware and software for the Illinois Geographic Information

System are being installed by the Environmental Systems Research Institute (ESRI) of Redlands, California. Installation should be completed by the fall of 1983.

12. Table 3 lists the basic technical capabilities of each NRIS. Many of the systems use software developed for their specific needs, but a variety of commercial software systems also are in use. The ESRI appears to be the leading commercial firm marketing software packages for geographic information systems.

13. The ESRI system is designed to meet information needs of groups involved in project planning and environmental impact assessment. Numerous installations of ESRI software exist in the United States and foreign countries.

14. Calkins and Johnson (1981) reviewed existing, commercially available geographic information systems to identify those that could meet the data storage, retrieval, and analysis needs of the Rapid Deployment Joint Task Force for water resources and related data. Based on the technical capability of the system and the support service provided by the organization, the ESRI system was ranked first in this study.

Fee Schedule

15. With the exception of Alabama, Alaska, Illinois, and Rhode Island, all of the state information systems charge users for services. Generally, these charges are on a cost recovery basis. The New Mexico system charges a minimum $25 fee plus cost. The fee schedule for the Texas system is set by the governing task force.

16. A formal fee schedule for outside users of the Alabama, Illinois, and Rhode Island systems has not been established and, at the present time, there is no charge to users of the Alaska system.

Systems in Operation

17. Descriptions of the state NRIS listed in Table 1 are provided in Appendix A. More detailed information is given for the systems in Minnesota, Ohio, and Texas. The descriptions include background information; types of data in the system; and the format and georeferencing systems used for data storage, manipulation, and analysis.

Additional Statewide Systems Planned

Kansas

18. The possibility of developing an NRIS or assuming management of an existing system developed by a state university has been explored by several states. One such system is the Kansas Applied Remote Sensing (KARS) Program established in 1972 at the University of Kansas by the National Aeronautics and Space Administration (NASA). The purpose of the KARS Program was to conduct applied research on techniques that would enable public agencies and private industry to better utilize available satellite and airborne remote sensing data. This program provides a full range of remote sensing, mapping, geographic information analysis, and related services to facilitate the tasks of state agencies.

19. The KARS Program was funded by NASA from 1972 through 1982; however, beginning in Fiscal Year 1983 (FY 83), NASA will phase out support of the program over a 3-year period. During this time, the State of Kansas will make provisions for retaining and using the existing staff and equipment of the KARS Program.

20. As a result of the phaseout of NASA funds, the Kansas Interagency Task Force on Applied Remote Sensing was established in the spring of 1982. One objective of the Task Force was to evaluate ways in which the KARS Program could be most efficiently and effectively maintained.

21. One of the options favored by the Task Force is to expand the present system over a 5-year period into a statewide information clearinghouse for use by all state agencies. The proposed system would be similar to the Texas Natural Resources Information System. The members of the Task Force unanimously supported a recommendation to the Kansas State Legislature that funding be appropriated for the KARS Program for FY 84. Such funding would enable the program to continue during FY 84 and would allow the Task Force to complete its review of various long-range options to maintain the program. For additional information about the KARS Program, contact Ms Loyola Caron, (913)864-4775.

Washington

22. The State of Washington is finalizing a geographic information system to be called GEOMAPS. The final request for proposals was submitted to vendors in February 1983. This system is being developed to aid the Department of Natural Resources in the management of the nearly 3 million acres

(approximately 12,000 sq km) of land for which the Department is responsible. Further information on the status of this system can be obtained from Mr. Glenn A. Yeary, (206)753-1262.

Connecticut

23. The State is cooperating with the University of Connecticut, Department of Renewable Resources, in an experimental project to develop a geographic information system. Software being installed for this project is GIRAS, a package developed by the U. S. Geological Survey, and MAP (Map Analysis Package) developed by Mr. Dana Tomlin at Yale University. Mr. Michael Prisloe, (203)566-3540, is the point of contact for information on the status of this system.

Discontinued State Systems

Iowa

24. The State of Iowa developed an experimental geographic information system; however, the program did not become a functional system. The Iowa Geologic Survey maintains an automated system that includes statewide water, geologic, and climatic data. Use of the system is very restrictive. For information concerning the availability of data in this system, contact Mr. Dick Talcott, (319)338-1173.

Georgia

25. The State of Georgia, in cooperation with Georgia Institute of Technology, experimented with a geographic information system. The system was never fully developed, however, and the various state agencies now maintain separate databases. One agency, the Department of Environmental Protection of Natural Resources, maintains a system that includes limited statewide environmental data such as water supply locations, water quality records for community and industrial sewage treatment plants, and air quality data. Mr. Jim Setser, (404)656-6905, is the point of contact for information concerning the availability of data from this system.

Others

26. California, Montana, North Dakota, South Dakota, and Vermont had operational systems that, for various reasons, no longer exist. The Montana system had been in operation since 1972. Most of these systems relied heavily upon Federal funding and were terminated when funding was discontinued.

Ohio PEMSO System

27. In addition to its Capability Analysis Program (Appendix A), the State of Ohio has a second system, the Planning and Engineering Data Management System for Ohio (PEMSO), which is not service oriented. The PEMSO evolved from the obligations of the Ohio Environmental Protection Agency to compile and manipulate large amounts of environmental planning and management information.

28. The PEMSO was developed by W. E. Gates and Associates, Inc. The basic structural unit of the PEMSO system is the triangle. The major components of the system include the PEMSO areal units (triangles and operational planning areas, generally counties); the digital terrain model (a computerized representation of the topographic features of a region); and the PEMSO database which includes all of the attributes and variables stored in the system.

29. U. S. Geological Survey 7.5-min topographic maps were used as base maps for the digital terrain model. Triangles were fitted to the terrain according to the magnitude of the slope. A triangle file, which includes the topographic data and the attribute data, was then created for each county. An individual triangle is homogeneous with respect to all of its attributes and can range in size from less than one acre to several hundred acres, with an average size of 60 acres (0.2 sq km).

30. Triangles may be redefined if necessary to reflect additional attributes for an area or to obtain a more precise representation of an area. Data may be displayed in a polygon form when adjacent triangles share sets of common attributes. The boundaries of the polygons are defined in terms of triangle sides.

31. The Ohio state planar coordinate system is used to geographically reference data stored in PEMSO. The following data categories are included in the PEMSO data base:

a. County boundaries.
b. Cities.
c. Villages.
d. Townships.
e. Major river basins.
f. Intermediate basins.
g. Subbasins.
h. Facility planning areas.

i. Existing sewer service areas.

j. Regional water and sewer districts.

k. Conservancy districts.

l. Traffic zones.

m. Water quality management areas.

n. PEMSO Population Districts.

o. Regional Planning and Development Commission boundaries.

32. Additional information about the PEMSO system can be obtained from Mr. Charles Chao, (614)466-7273.

PART III: CONCLUSIONS AND RECOMMENDATIONS

Conclusions

33. The primary function of all of the natural resource information systems is to provide a cost-effective system for collecting, storing, processing, and delivering data to agencies that are involved in planning, developing, managing, and conserving natural resources.

34. With the exception of Ohio's Capability Analysis Program, the 22 state systems included in Appendix A all use a gridded or polygon format to manipulate and analyze data. All state systems use the Universal Transverse Mercator grid system to geographically reference data, with the exception of the Maryland, Nebraska, and New Jersey systems, which reference data to state planar coordinates.

Recommendations

35. The status of geographically referenced natural resource information systems is constantly changing. New systems are being developed while some existing systems, for various reasons, are being discontinued; data are being updated; new data are being incorporated into existing systems; and user services are being expanded. As a result of these changes, this survey needs to be updated on a regular basis. In addition, a more in-depth evaluation of the state databases could be helpful.

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Calkins, H. W., and Johnson, T. R. 1981. "Military Hydrology; Report 4, Evaluation of an Automated Water Data Base for Support to the Rapid Deployment Joint Task Force (RDJTF)," Miscellaneous Paper EL-79-6, prepared by Department of Geography, State University of New York at Buffalo, for U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.

Cornwell, Sally B. 1981. "History and Status of State Natural Resources Systems," Urban and Regional Information Systems Association, Bethesda, Md., paper presented at the Urban and Regional Information Systems Association Conference, New Orleans, La.

Mead, D. A. 1981. "Statewide Natural-Resource Information Systems--A Status Report," Journal of Forestry, Vol 79, No. 6, pp 369-372.

Tessar, P. A., and Caron, L. B. 1980. "A Legislator's Guide to Natural Resource Information Systems," National Conference of State Legislatures, Denver, Colo.

Table 1

Statewide Computer-Based Natural Resource Information Systems
(Operational, April 1983)*

State	Point of Contact, Telephone	Address
Alabama	Mr. Walter Stevenson (205)832-3823	Department of Economic and Community Affairs State Planning Division Montgomery, Ala. 36130
Alaska	Mr. Robert Bennett (907)265-4559	Department of Natural Resources Division of Research and Development Anchorage, Alaska 99510
Arizona	Mr. Paul Tessar (602)255-4061	Arizona Land Resources Information System State Land Office 1624 W. Adams St. Room 302 Phoenix, Ariz. 85007
Colorado	Mr. Robert Puterski (303)866-2351	Colorado Department of Local Affairs Planning Division Denver, Colo. 80203
Illinois	Mr. Tim Johnson (217)785-8589	Department of Energy and Natural Resources ENR 325 West Adams Springfield, Ill. 62706
Kentucky	Mr. Larry Schneider (502)564-5174	Department of Surface Mining Reclamation and Enforcement Division of Reclamation Sciences Capital Plaza Tower Frankfort, Ky. 40601
Louisiana	Mr. Glen Daigre (504)342-7410	Louisiana Areal Resource Information System Office of State Planning Baton Rouge, La. 70804
Maryland	Ms. Susan Alderman (301)383-5664	Department of State Planning 301 West Preston Street Baltimore, Md. 21201-2365

* See paragraphs 18-23 for information on other state NRIS in the planning phase.

Table 1 (Continued)

State	Point of Contact, Telephone	Address
Michigan	Mr. Mike Scieszka (517)373-3328	Department of Natural Resources Division of Land Resource Programs Box 30028 Lansing, Mich. 48909
Minnesota	Dr. Alan Robinette (612)296-1211	Minnesota Land Management Information System Department of Energy Planning and Development St. Paul, Minn. 55101
Mississippi	Mr. Paul E. Downing (601)982-6339	MARIS Systems Central Mississippi Research and Development Center Geographic Information System Division Jackson, Miss. 39211
Nebraska	Dr. Mahendra K. Bansal (402)471-2081	Nebraska Natural Resources Commission Data Bank Section 301 Centennial Mall South P. O. Box 94876 Lincoln, Nebr. 68509
New Jersey	Mr. Robert Mills (609)984-2281	Department of Environmental Protection Office of Cancer and Toxic Substance Research Information Resource Center Trenton, N. J. 08625
New Mexico	Mr. Bill Isaacs (505)827-7830	State of New Mexico Natural Resources Department Villagra Building Santa Fe, N. Mex. 87503
New York	Mr. Robert Crowder (518)474-7721	State of New York Department of Commerce 99 Washington Avenue Albany, N. Y. 12245

Table 1 (Concluded)

State	Point of Contact, Telephone	Address
North Carolina	Ms. Karen Siderelis (919)733-2090	Department of Natural Resources and Community Development Division of Land Resources P. O. Box 27687 Raleigh, N. C. 27611
Ohio	Mr. Wayne Channell (614)265-6778	Ohio Department of Natural Resources Division of Soil and Water Districts Fountain Square Columbus, Ohio 43224
Rhode Island	Mr. John J. Deary, Jr. (401)277-2656	Rhode Island Department of Administration Statewide Planning Program 265 Melrose Street Providence, R. I. 02907
South Carolina	Mr. Gerald R. Minick (803)777-7236	University of South Carolina Computer Service Division Columbia, S. C. 29208
Texas	Mr. Sam McCulloch (512)475-3321	Texas Natural Resources Information System P. O. Box 13087 Capitol Station Austin, Texas 78711
Utah	Mr. Bruce Plott (801)533-5333	Utah Department of Natural Resources and Energy Outdoor Recreation Agency 1636 West North Temple Salt Lake City, Utah 84116
Virginia	Mr. Edwin Sahaydek (804)257-8064	Commonwealth Data Base Department of Taxation P. O. Box 6-L Richmond, VA 23282

Table 2

State Natural Resource Information Systems Supplying Data

to U. S. Army Engineer Divisions/Districts

State	System	Division/District	Form of Data
Minnesota	Minnesota Land Management Information System	St. Louis District St. Paul District*	Maps Statistical data
Nebraska	Nebraska Natural Resources Information System	Omaha District	Statistical data Magnetic tapes
New Mexico	New Mexico Natural Resources Information System	Albuquerque District	Maps Statistical data
New York	New York Land Use and Natural Resource Inventory	Buffalo District	Map overlays
Ohio	Ohio Capability Analysis Program	Louisville District Huntington District**	Maps Statistical data
Rhode Island	Rhode Island Statewide Planning Program	New England Division**	Map Statistical data
Texas	Texas Natural Resources Information System	Fort Worth District* Galveston District Southwestern Division Hydrologic Engineering Center, Davis, Calif.	Printed report Maps Magnetic tape Indices

* District can access data directly through use of remote terminals.

** Data were furnished to the Corps Division/District indirectly through a contractor.

Table 3

Basic Hardware and Software of State Natural Resource Information Systems

State	Hardware	Software
Alabama	Hewlett Packard 3000/4 Computer (in-house) and IBM 3032 Computer (Auburn University) Comtal Image Display Device	Earth Resources Laboratory Analysis System (ELAS) Environmental Systems Research Institute (ESRI) Grid and Automap Packages
Alaska	Data General MV-8000 Computer Talos Digitizer Zeta Plotter Tektronix Graphic Terminals	ESRI COMARC Polygon-Software by COMARC Systems
Arizona	Prime 550 Computer Lex-i-data Display System Tri-Log Color Printer Plotter Zeta Plotter	ELAS ESRI ToPo Package Developed In-House
Colorado	Prime Computer and Printers Talos Digitizer Houston Plotter	ESRI
Illinois	Prime Computer Graphic CRT's Xerox Daisy-Wheel Printer	ESRI
Kentucky	Prime 750 Computer Versatec Electrostatic Printer Plotter Talos Digitizer Princeton Graphic CRT DeAnza Color Display Monitor Houston Instrument 3-Pin Plotter	ELAS ESRI INFO (software package marketed by Prime)

(Continued)

Table 3 (Continued)

State	Hardware	Software
Louisiana	IBM 3330 and Data General C-300 Computers Tektronix CRT with Hand Copy Capability Standard Line Printers	Geographic Information Retrieval and Analyses System (GIRAS) developed by the U. S. Geological Survey Software developed in-house
Maryland	Univac 1180 Computer Apple 2 Mini Computer Digital Equipment Corp. Printers Calcomp Plotter DICOMED Image Recorder	ESRI Software developed specifically for the Maryland program
Michigan	Burroughs B770 and Intergraph Computer Calcomp Plotters Altec Digitizer Tektronix Graphics Terminal with Hard Copy Capability	Intergraphs' Interactive Graphics and Design System (IGDS) Software developed in-house
Minnesota	Prime 850 Computer Versatec Electrostatic Plotter Houston Instrument 3-Pin Plotter Tri-Log Color Plotter DeAnga Color Display Monitor	ESRI Environmental Planning and Program Language (EPPL) developed in-house ELAS
Mississippi	Digital Equipment Corp. PDP 1124 Computer Calcomp Digitizer, Dot Matrix Printer (turnkey system purchased from Earth Resources Data Analysis Systems Corp., Atlanta, Ga.)	Digital Equipment Corp. (DEC) Software Earth Resources Data Analysis Systems Corp. Software
Nebraska	IBM 370 MVS Computer IBM 3203 Line Printer	Hydrologic Information Storage and Retrieval System (HISARC) developed by North Carolina University Software developed in-house

(Continued)

Table 3 (Continued)

State	Hardware	Software
New Jersey	Intel AS-5000 Computer Tektronix Digitizing Station Calcomp 936 Plotter DeAnza Image Processor	RAMIS (Rapid Access Management Information System)
New Mexico	Amdahl 470 Computer Digital Equipment Corp. Printer Data Media Elite 3045 CRT's	ELAS Software developed at New Mexico State University
New York	IBM 360 Computer and Standard Line Printers	DATALIST I, PLANMAP II, and PLANMAP III developed by Cornell University
North Carolina	Data General Computer Zata Plotter Calcomp Digitizer Tektronix Graphic Terminal	COMARC Software developed by Comarc Systems
Ohio	IBM 370 and Harris 1660 Computers Harris Drum Printers K&E Digitizers Calcomp Plotter	Ohio Capability Analys.s Programs (OCAP) developed in-house
Rhode Island	Molecular Infinet 1 Computer Adds Vicropoint Terminals 300 LPM Printronix Printer	Software by Molecular

(Continued)

Table 3 (Concluded)

State	Hardware	Software
South Carolina	IBM and Data General Computers & Printers Bendix Digitizers Calcomp Drum Plotter Kongsburg Flatbed Plotter Gould Electrostatic Plotter Comtal Vision 1/20 Image Display	ELAS ESRI
Texas	Univac 1100/62 & Interdata 7132 Computers Centronics 101AL Printers Tektronix 4014 Graphics Terminal with Hand Copy Capability Bendix Digitizer Calcomp Model 748 Plotters RAMTECH 9050 Color Graphics Display	DISSPLA developed by Integrated Software Systems Corp. SYMAP, SYMVU, and CALFORM developed at Harvard University UNITECH (now RADIAN) CPS-1 Contour Plotting System Calcomp software
Utah	AMDAHL & Wang (Mini) Computer Talos Digitizer Houston Instrument Plotter Tektronix Graphic Terminal	ESRI
Virginia	VAX 1178 Prime 750	GIPSY developed by the University of Kansas

APPENDIX A: AUTOMATED STATEWIDE NATURAL RESOURCE INFORMATION SYSTEMS

Alabama Resource Information System

1. The Alabama Resource Information System (ARIS) was developed by Auburn University under contract with the National Aeronautics and Space Administration and the Alabama Development Office. The name of the Alabama Development Office has since been changed to the Department of Economic and Community Affairs.

2. The ARIS was developed to reduce or eliminate some of the difficulties faced by planning and decision-making personnel, such as: (a) data sources either unknown or unavailable, (b) data in a form that is inconvenient or difficult to use, and (c) too much data from which to select those items relevant to the problem. ARIS consists of a database and a set of computer programs, along with operating procedures, for analysis and output in a form that is valuable to the decision maker.

3. Data can be stored in the ARIS system in either polygon or gridded format; however, all programs require that data be input in a gridded format. The Universal Transverse Mercator system is used for locating the geographical attributes. All grid cells are referenced to a single unique extreme northwest point on a UTM grid overlying the entire state. This allows all separate databases to be interrelated with minimal boundary conflict.

4. Statewide data included in the system at the present time are land use/land cover, transportation, general soils, topography, slope, and flood damage areas. Although somewhat outdated, several user manuals are available to describe the system.

Alaska Geoprocessing System

5. The Alaska Department of Natural Resources maintains a computer-based geographic data processing system that is available for special projects and resource inventory tasks. The system, managed by the Division of Research and Development, became operational in 1980.

6. The system provides the following services: applications consulting, project planning and supervision, in-house digitizing and data entry, project

production, user training, and data librarying.

7. Data are stored in polygon and gridded format, but conversions between the two can be accomplished readily. The Universal Transverse Mercator, state planar, and latitude/longitude coordinate systems can be accommodated. Product output can be in the form of printed summaries and area reports; hard copies of screen images; line printer maps; and multicolor maps plotted on paper, acetate, or mylar.

8. No statewide data are in the system at this time. Vegetation, soils, land use, and geology data are available for some areas. Data are added to the system as specific projects are completed.

Arizona Land Resource Information System

9. Development of the Arizona Land Resource Information System (ALRIS) was initiated in 1981. The system is housed in the State Land Department.

10. Data are stored in either polygon or gridded format. The system has the capability of switching from one format to the other. The bulk of the data in the system is referenced to the Universal Transverse Mercator coordinate system; however, the state planar coordinate system or latitude/longitude can be used.

11. The system is still in the development stage, and the only statewide data in the system at this time are topography, vegetation and land cover (excluding Federal land), and section lines and land ownership.

Colorado Automated Mapping System

12. The Colorado Automated Mapping System has been in existence approximately 2-1/2 years but functional for only about 10 months. The system is housed in the Department of Local Affairs and is maintained by personnel of that office.

13. Data are entered and stored in the system in polygon format, but they can be gridded for use. All data are referenced to the Universal Transverse Mercator coordinate system.

14. Statewide data in the Colorado Automated Mapping System at the present time include census geography, water wells (public and private), elevation, water and sanitation districts, and recreation districts.

Illinois Geographic Information System

15. The Illinois Geographic Information System is being installed by Environmental Systems Research Institute (ESRI), Redlands, California. ESRI is supplying hardware and software for the system. The system will be maintained by the Lands Unsuitable for Mining Program of the Department of Energy and Natural Resources.

16. Installation of system should be completed by fall 1983. Statewide data at a scale of 1:500,000 will be entered in the system for land use, major coal seams, surface and bedrock geology, soil associations, Soil Conservation Service land resource areas, high groundwater yield areas, and natural vegetation.

17. The system will have the capability to reference data to several coordinate systems. A polygon format will be used for data storage.

Kentucky Natural Resources Information System

18. The Kentucky Natural Resources Information System (KNRIS) was developed by the Kentucky Department of Natural Resources and Environmental Protection. The initial impetus for the development of KNRIS was the Federal Surface Mining Control and Reclamation Act of 1977, which required all states to establish a "data base and inventory system" to carry out certain environmental assessments mandated by the act. In addition to the direct application to the surface mine regulatory program, the system can be utilized for a wide range of other environmental investigations and planning efforts by other agencies. The system has been operational for approximately 2-1/2 years.

19. The KNRIS is composed of three interrelated components: (a) an information resource center, (b) an automated remote sensing facility, and (c) an automated map analysis and display system. The information resource center is a map and document library containing maps, books, and reports on a variety of natural resources and associated topics. An automated system is used to catalogue all materials and permit rapid data searches by author, title, subject, and geographic area. Aerial photography covering the state is also available, along with interpretation and mapping equipment for analysis. The automated remote sensing facility processes Landsat and other remotely sensed data in computer-compatible form. A color image processing and display system and a

NASA software package are used for Landsat tape analysis. The automated map analysis and display system is a geographic information system that includes software and computer graphics hardware for the input, manipulation, and display of geographic information.

20. Map information can be stored in grid cell format, polygon format, or as point/line data. Although a variety of coordinate systems can be used, the two most commonly used are the Universal Transverse Mercator system and latitude-longitude.

21. Automated geographic variables in the KNRIS are classified in six major units and subdivided as follows:

a. Terrain Units
   (1) elevation
   (2) physiographic province
   (3) landform
   (4) slope gradient
   (5) geologic formation
   (6) mineral resources
   (7) groundwater availability zones
   (8) vegetation type
   (9) land use
   (10) flood-prone areas
   (11) forest density
   (12) natural soil group

b. Surface Hydrology
   (1) watershed boundaries
   (2) stream network (line data)
   (3) river mile index (point data)

c. Boundary Units
   (1) county
   (2) incorporated areas
   (3) ownership
   (4) administrative status
   (5) important wildlife habitats
   (6) state and national forests
   (7) state and national parks
   (8) important geologic and karst areas

(9) caves (point data)

(10) recreation sites (point data and polygon)

d. Infrastructure (line or point data)

(1) roads

(2) landfill sites

(3) coal mining

(4) extractive activity (non-coal)

(5) land use

(6) trails

(7) communication and transportation facilities

(8) power transmission facilities

(9) railroads

(10) pipelines

e. Surface Coal Mine Permit Data

(1) permit boundaries

(2) haul roads

f. Abandoned Mine Lands (AML) Inventory Problem Areas - contains mapped boundaries of AML problem areas with number codes assigned by the Division of Orphan Mine Land Reclamation

Louisiana Areal Resource Information System

22. The Louisiana Areal Resource Information System (LARIS) is housed in the Louisiana State Planning Office. The system has been operational since 1979.

23. Data in the LARIS can be stored in either a polygon or gridded format and are referenced to the Universal Transverse Mercator coordinate system.

24. Statewide data in the LARIS include land use for 1972 and 1979, political boundaries, soil associations, hydrologic basins as defined by the U. S. Geological Survey, surface geology, and census data. Detailed soil surveys for 30 parishes are being entered in the system.

Maryland Automated Geographic Information System

25. The Maryland Department of State Planning maintains the Maryland Automated Geographic Information (MAGI) System. The system was designed to serve as an efficient and accurate tool to aid in analyzing land use and

natural resource planning problems and has been used extensively by state and local agencies.

26. The MAGI system consists of a statewide database containing nearly 88,000 grid cells and a package of software routines for the storage, retrieval, manipulation, and display of geographic grid-referenced data. The state planar coordinate (SPC) system is used to reference the data. Each 10,000-ft (3,050-m) grid corresponds to the SPC grid line and is subdivided into 2,000-ft (610-m) grid cells containing 91.8 acres (37 ha) each. For some special studies the 2,000-ft grid cells are subdivided into twenty 400-ft (120-m) by 500-ft (150-m) grid cells containing 4.57 acres (1.8 ha) each. Multiple levels of data encoding are used with the dominant or largest data polygon in the grid cell becoming the primary occurrence and the smaller data polygon being encoded as secondary as tertiary occurrences.

27. The following variables are included in the statewide database.

a. Physical Data Variables

(1) natural soils groups
(2) topographic slope
(3) geology
(4) hydrology (water quality)
(5) mineral resources
(6) vegetation cover types
(7) unique natural features and scenic areas
(8) endangered species
(9) bay bathymetry
(10) edge effects
(11) stream classifications
(12) wetlands

b. Cultural Data Variables

(1) 1970 land use/land cover
(2) 1973 land use/land cover
(3) 1978 land use/land cover
(4) county sewer/water service areas
(5) non-highway transportation facilities
(6) county comprehensive plan
(7) public properties
(8) historic sites

(9) highways

(10) outdoor recreation/open space

(11) archaeological sites

c. Areal Data Variables

(1) county boundaries

(2) watershed boundaries

(3) election districts

(4) cell identification (row/column coordinates)

28. Data are updated at intervals depending upon the frequency of the use of the variable and the dynamic nature of variables. Updates are performed at 1- to 4-year intervals for most of the cultural variables.

29. A variety of output products and formats is available to MAGI users. The most commonly used and economical output device for maps is the standard line printer. Line printer tabulations of output calculations, Calcomp electromechanical plotter maps, and output maps from the DICOMED image recorder are also available.

Michigan Resource Inventory Program

30. Public Act 204 (the Michigan Resource Inventory Act) was passed by the Michigan State Legislature in 1979. The act provided for a land resource and current use inventory for the state and requires that current land cover/use and land resource inventory information be gathered, stored, and output in a manner and format accessible and useful to decision makers in the state. A gubernatorial advisory committee (Inventory Advisory Committee) was appointed to administer the Michigan Resource Inventory Program.

31. The Michigan Resource Inventory Program is still in the developmental stage. Existing information is being organized and new data gathered. The data are being stored in geographic unit files coinciding with county boundaries. At the present time, 23 of the 83 counties in Michigan have data coverage in the system. Data for the entire state should be in the system in approximately 3 years.

32. Data are most frequently referenced to the state planar coordinate system, but data can be translated to latitude/longitude or the Universal Transverse Mercator coordinate system. The data are stored in point, polygon, or gridded format. Some of the types of data being stored in the system are

soils, slopes, mineral deposits, special and unique features, and seven broad categories of land cover/use (urban and built-up lands, agricultural lands, forested, nonforested, water, wetland, and barren lands).

33. Data output can be in the form of maps and graphics, tabulations, statistics, and reports. The Inventory Advisory Committee is formulating a cost plan for users of the system.

Minnesota Land Management Information System

34. The Minnesota Land Management Information System (MLMIS) evolved from a program designed to collect information about outdoor recreation in the early 1960's, when the state legislature created the Minnesota Outdoor Recreation Resources Commission, which has since been renamed the Legislative Commission on Minnesota Resources.

35. In 1967 the Commission funded a statewide inventory, conducted by the University of Minnesota, of the state's lake resources and the residential development problems that were occurring in those areas. From the results of this study, it was determined that a computerized data bank could be a valuable management and research tool for government decision makers. The development of the MLMIS was a cooperative project between the University of Minnesota and the State Planning Agency. A 1969 land-use map was the first major product of this system on a statewide basis. At the present time, the MLMIS is administered and maintained by the Department of Energy Planning and Development; however, a bill is in the Legislature to return administration of the system to the State Planning Agency.

36. From its inception through 1980, the MLMIS operated in a time-sharing mode, using the University of Minnesota's computer facilities. Beginning in 1980, the system began a changeover to its own minicomputer system, consisting of a Prime computer with CRT terminals, a digitizing work station, an image processing station to analyze Landsat data, and black-and-white and color printer plotters.

37. The 40-acre (16-ha) parcel, based on the U. S. Public Land Survey, is the predominant geographic entity for which statewide data are entered in the MLMIS. Data are geographically referenced to the Universal Transverse Mercator system. Data can be accessed by region, county, or township for mapping or statistical analysis. In addition to the 40-acre (16-ha) cell

database, data have been collected for cells of 2.5 acres (1 ha) or smaller.

38. Thirteen items of information are recorded for each of the 1.4 million 40-acre (16-ha) parcels in the state. These variables are as follows:

a. Township
b. Minor civil division
c. Public ownership
d. Type of acquisition of state or county-owned land
e. Highest recommended use of state or county-owned land
f. Recommended disposition of state or county-owned land
g. Management unit status of state or county-owned land
h. Land use
i. Forest cover
j. Water orientation
k. Highway orientation
l. Soil landscape unit
m. Geomorphic regions

Data will be updated and other available statewide data entered as this becomes feasible.

39. For some areas of the state, additional information is available such as geology, more detailed soils data, detailed agricultural land use, and zoning districts.

40. The MLMIS functions as a service agency, on a charge basis, to provide data and technical assistance needed for management decisions.

Mississippi Automated Resource Information System

41. The Mississippi Automated Resources Information System (MARIS) is located in the Mississippi Research and Development Center. Three committees were established from members of 16 state agencies to provide guidance and direction to the system's development. The largest of these committees is the MARIS task force. The MARIS task force is made up of two representatives from each of the 16 state agencies and coordinates technical aspects of the system's development. The policy committee, composed of the heads of the 16 state agencies, sets MARIS policy; the executive committee, with three voting members elected by the policy committee and two advisory members, is responsible for directing MARIS operations.

42. Statewide data have been entered into the system using 62.5-acre (25-ha) cells referenced to Universal Transverse Mercator coordinates. The state database includes land use, soil types, flood-prone areas, watershed boundaries, prime agricultural lands, land capability units, noise hazard areas, and water and sewer districts.

43. In February 1983, a new computer system was installed that has the capability for geographic data analysis, Landsat interpretation, planimetric measurements, and the digital input of cartographic data. This should permit MARIS to use more effective approaches to resource management and analysis applications.

Nebraska Natural Resource Information System

44. Establishment of the Nebraska Natural Resource Information System (NNRIS), administered by the Nebraska Natural Resources Commission, was authorized by the legislature in 1969. All data files and supporting software (the Natural Resources Data Bank) used in the NNRIS are stored and processed at the University of Nebraska, Lincoln Computing Facility.

45. The NNRIS has stored and processed information on a wide variety of soil and water related subjects for over a decade. Currently, the following data are available in the Natural Resources Data Bank.

a. Rainfall
b. Temperature
c. Snowfall
d. Evaporation/wind movement
e. Events, occurrences
f. Water temperature
g. Hourly rainfall
h. Streamflow
i. Peak streamflow
j. Surface water rights
k. Well registration and permits
l. Canal diversion
m. Reservoir storage
n. Miscellaneous discharge
o. Dams inventory
p. Public health drinking water monitoring
q. Water quality
r. Agricultural crops
s. Demographic data
   (1) by county and age groups
   (2) by county, sex, and race
t. Soil mapping units
u. Soil interpretations
v. Conservation needs inventory
w. Groundwater levels
x. Land use

46. Data are geographically referenced to the state planar coordinate system. Data can be retrieved in either a gridded or tabular format by county, township, and range, or by watersheds.

47. The services of the NNRIS are available to all users, including public and government agencies. Several user manuals are available. The NNRIS staff can retrieve needed information in numerous formats; with a compatible remote terminal, the user can be linked directly with the Data Bank.

New Jersey Geographic Information System

48. New Jersey has a geographic information system (GIS) maintained by the New Jersey Department of Environmental Protection. The GIS was developed by the Office of Cancer and Toxic Substance Research with State appropriations and funding from the National Cancer Institute. The New Jersey GIS has been in operation approximately 4 years.

49. The state planar coordinate system is used to geographically reference date. Data are stored in the system in gridded, polygon, or line format depending on the type.

50. The following statewide data are currently in the New Jersey GIS:

a. County/municipal boundaries
b. Watershed boundaries
c. Landsat data
d. Tidelands state claims
e. Green acres acquisitions
f. National wetlands inventory
g. Deer Zone Management Unit
h. Forest fire districts
i. Abandoned site location
j. Fish PCB sampling locations
k. Toxics in groundwater
l. Geodetic monuments
m. Plant locations
n. Store locations

The system also contains other types of data for specific areas of the state. The current GIS capability emphasizes both the information needs of management and the research needs of the Office of Cancer and Toxic Substance Research.

New Mexico Natural Resources Information System

51. The New Mexico Natural Resources Information System (NRIS) evolved from an earlier automated system, the Heritage Information and Statistical System. The present NRIS was developed by the New Mexico Natural Resource Department in cooperation with the Technology Application Center of the University of New Mexico, Albuquerque. The system has been functional since 1980.

52. The NRIS, designed to be extremely flexible, consists of six subsystems housing a diverse collection of databases and a set of interrelated management programs designed to perform correlations and investigate relationships within and between the various databases.

53. Data input and retrieval techniques are generally based upon the township/range coordinate system with the exception of map data, which usually is referenced to the Universal Transverse Mercator grid system. Data can also be geographically referenced by latitude/longitude.

54. The following databases are in the New Mexico NRIS:

a. Big game
b. Geology
c. Paleontology
d. Natural areas
e. Vegetative cover
f. Soils
g. Hydrology
h. Rare and endangered plant and animal species
i. Common species
j. Recreation
k. Aquatic/wetlands
l. Land contour/aspect/slope
m. Land ownership
n. Energy development and corridors
o. Laws and regulations
p. Element abstract file (abstracts of all rare and endangered species of plants, animals, ecological features, natural areas, and geological features)
q. Mine reclamation sources for vegetative cover

55. The NRIS is available to both public and private groups.

Approximately 100 users utilize the system annually.

New York Land Use and Natural Resource Inventory

56. The Land-Use and Natural Resource (LUNR) Inventory originated in 1966 when Governor Rockefeller requested the Office of Planning Coordination to develop a natural resource inventory of the state. Cornell University was the State's prime contractor for the aerial photointerpretation and computerization of land-use and other data sets. In 1971, during the restructuring of New York State's priorities and political structure, the Office of Planning Coordination was abolished and its planning functions were reorganized into a smaller state planning agency called the Office of Planning Service (OPS). The OPS existed for about 4 years and, since 1975, the LUNR Inventory has been administered by various agencies. Presently, the LUNR Inventory is housed in the State Department of Commerce and is operating at a low level.

57. In 1976, the Resource Information Laboratory at Cornell University, which provided services related to the LUNR Inventory, was organized under the management of the New York State Cooperative Extension Service. All original data for the LUNR Inventory are now stored in the Cooperative Extension Service Office at Cornell University.

58. The LUNR Inventory is a statewide inventory of 51 areal land uses with supplementary point data and additional natural resource information in a computerized data bank. The land-use data are based on aerial photography taken from the spring of 1967 through 1970. The land-use data for six counties and certain towns in the New York Catskill Mountains area were updated in 1974.

59. The major land-use categories in the LUNR Inventory include Agriculture, Forest Land, Water Resources, Wetlands, Residential, Commercial, Industrial, Outdoor Recreation Land Use, Extractive Industry, Public and Semi-Public Land Uses, Transportation Land Uses, and Non-Productive Land. Each major category is subdivided into a number of minor categories. Supplementary data in the LUNR Inventory include generalized soils data for the state, geology, economic viability of farm areas, depth to bedrock, and primary and secondary county and minor civil division boundaries.

60. The computerized data storage system for the LUNR Inventory is based upon 1-sq-km cells in a statewide grid system referenced to the Universal Transverse Mercator (UTM) grid system. Each 1-sq-km grid cell (140,000 grid

cells are needed to cover all of New York State) is assigned a number that is the coordinates of its southwest corner in the New York UTM grid system. This grid system allows rapid analysis, compatibility with more detailed data storage for intensively studied areas, coordination with Federal mapping and satellite programs, and coordination with similar data storage systems.

61. Data can be displayed on transparent mylar film overlays to U. S. Geological Survey 7.5-min quadrangle maps or as opaque paper prints available from LUNR User Services, Cornell University. Tabular summaries or shaded computer graphic maps are also available.

North Carolina Land Resources Information Service

62. The Land Resources Information Service (LRIS) is housed in the North Carolina Department of Natural Resources and Community Development, Division of Land Resources. LRIS, operational approximately 5 years, can perform complete land resource projects for clients, from data collection to data analysis, on a cost recovery basis.

63. A polygon format is used to store and manipulate data in the LRIS. Data are geographically referenced to the state planar grid system. Data referenced to either the Universal Transverse Mercator grid system or latitude/longitude can be entered into the system, but the data are translated to the state planar grid system for manipulation.

64. Statewide data currently in the LRIS include the following:

a. Generalized soils (U. S. Department of Agriculture, Soil Conservation Service soil association)

b. Topography, slope, aspect, elevation, contours

c. Land use/land cover

d. Water impoundment location

e. Subbasin drainage areas

f. Special and endangered plants and animals

g. 1970 and 1980 Census data (population, housing counts, municipality names, and enumeration districts).

Data can be retrieved by county, region, zip code area, or census areas.

Ohio Capability Analysis Program

65. The Ohio Capability Analysis Program (OCAP) is a computer mapping

and information storage system developed and maintained by the Ohio Department of Natural Resources (ODNR) to assist local agencies in the use of natural resource information. Land capability analysis is a method of evaluating the natural resources to determine their ability to support different types of development. OCAP is an important tool for consolidating information related to land resources and transferring the data in a usable form to agency officials responsible for making land-use decisions.

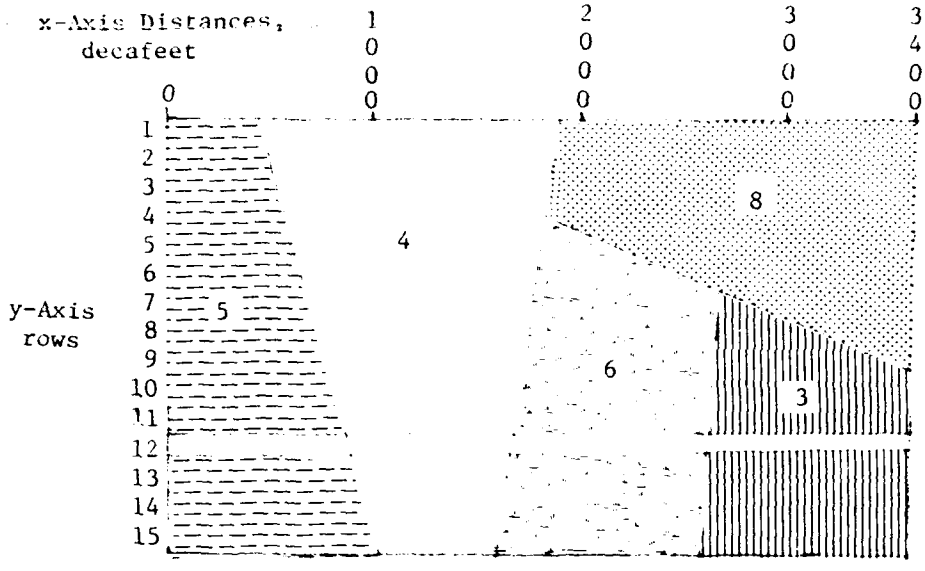
66. OCAP was developed in the early 1970's entirely with state funds. All software used by the system was developed in-house. Software is written in PL/1 computer language and is used in an IBM computer system.

67. Land capability analysis projects are conducted on a cost-sharing basis between ODNR and the county involved in the project. Currently, projects involving 30 of the 88 counties in Ohio have been completed and projects in 8 additional counties are in progress.

68. Each project is unique with respect to the data available for that area; however, all completed projects include soils, topography, geology, groundwater resources, and land-use data. Other data that might be included are political boundaries, watershed boundaries, recreation area, public water and sewer districts, flood-prone areas, school districts, transportation corridors, and census tracts.

69. Many computer-based geographic information systems use a grid cell or a polygon format for data storage and manipulation; however, the OCAP files are structured in a series of y-axis rows that overlie base maps (Figure A1). Each row of base map data is converted into a series of x-axis code/distance pairs. The data pair indicates the variable level code and the distance in decafeet (tens of feet) from the x-origin. In Figure A1, the data pair 50750 indicates a variable level of 5 (row crops) from the x-origin to a distance of 750 decafeet. Similarly, the data pairs 41130, 62375, and 33400 indicate a variable level of 4 (cover crops) from 750 to 1130 decafeet; a variable level of 6 (marshland) from 1130 to 2375 decafeet; and a variable level of 3 (brushland) from 2375 to 3400 decafeet, respectively. The first recording for each row indicates the variable and the number of the row. For example, LC012 indicates land cover data for row 12.

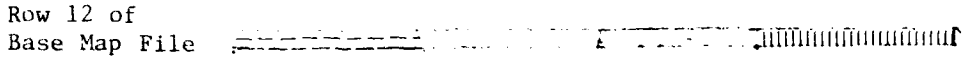
70. All projects are referenced to standard U. S. Geological Survey (USGS) 7.5-min quadrangle maps. Maps are aligned along lines of latitude with the left edge of the map designated as the x-origin. If a county consists of



Variable Levels For Land Cover

1. Bare soil
2. Water
3. Brushland
4. Cover crops
5. Row crops
6. Marshland
7. Coniferous forest
8. Deciduous forest
9. Airports
10. Urban

Format of Base Map File



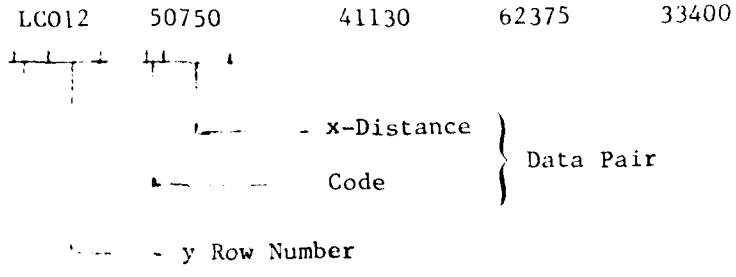


Figure A1. Data file structures and format of an OCAP land cover base map file

16 quadrangles, the origin of the study area is set to the northwest corner of the northwest quadrangle with all x and y measurements originating from this point (Figure A2). At a scale of 1 in. (25 mm) = 2000 ft (610 m), a USGS 7.5-min quadrangle map has 182, 1/8-in. (3-mm) rows to scan.*

71. It is desirable to have all base maps at a common scale. The base maps can be rescaled by one of the following methods:

a. Each base map can be digitized using a row scan of 1/8 in. regardless of the base map scale. The output file can then be rescaled to the common scale with the SCALE program.

b. The base map can be preprocessed manually or photographically to the common scale and the "new" base map can then be digitized.

c. The scan of 1/8 in. can be altered so that the number of rows for all base maps is equal. For example, a land cover map at a scale of 1 in. = 2000 ft would have 182, 1/8-in. scan lines while a geologic map at a scale of 1 in. = 4000 ft (1220 m) would have 182, 1/16-in. scan lines.

72. The OCAP users will be charged for services based upon the size and scale of the study area and the complexity of the final output product.

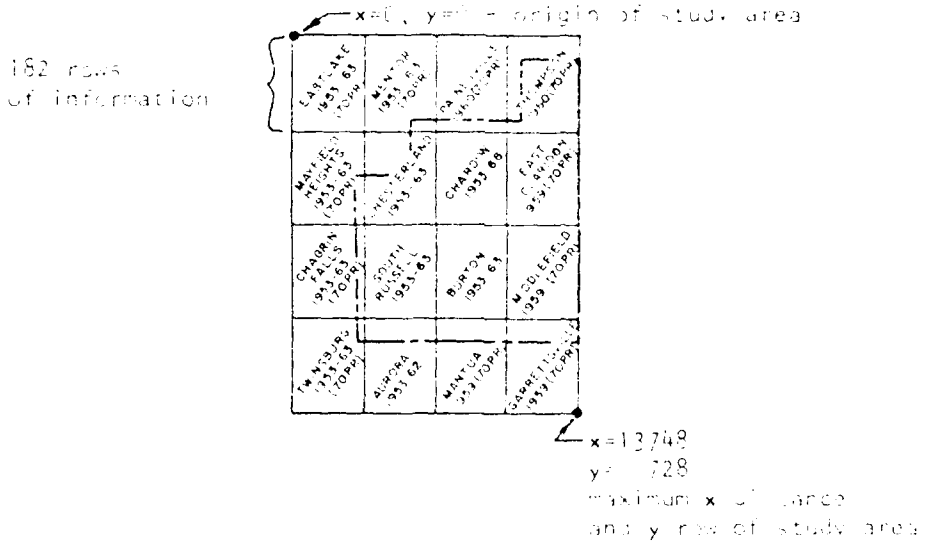


Figure A2. A county study area overlaid on U. S. Geological Survey 7.5-min topographic maps

* A vertical spacing of 1/8 in. for y-axis scan lines is used since the computer maps are printed on a line printer with a cell height of 1/8 in.

Rhode Island Statewide Planning Program

73. The Rhode Island Statewide Planning Program (RISWPP) is housed in the Office of State Planning. The system has been in operation approximately 10 years.

74. The RISWPP uses the Universal Transverse Mercator (UTM) system for georeferencing data. The UTM system is used because of its ability to cross state boundaries without the need for adjustments and to yield a grid of consistent size that is easily subdivided. The RISWPP uses a grid cell format to store and manipulate data. A cell size of 200 sq m (approximately 10 acres) is used for data encoding. Cells are coded according to the predominant type of variable within the cell.

75. The following data elements are currently in the RISWPP.

a. Analysis zones (subdivisions of census tracts based on population and area)

b. 1961, 1970, and 1975 land use

c. Municipal zoning

d. Recreation, conservation, open-space areas

e. Sites suitable for multiunit housing

f. Existing Federally assisted housing as of 1981

g. Present water quality (updated as changes occur)

h. Wetlands

i. Flood hazard areas

j. Public water service areas

k. Public sewer services

l. Groundwater aquifers and primary recharge areas

m. Soil classifications (1943 survey)

n. Soil classifications (1975 survey)

o. Vegetation types

p. Important farmlands

q. Slope

r. Historic and archaeological sites/districts

s. Highway accessibility

t. Transit routes and service areas

u. School locations

v. Public rights-of-way

w. Wildlife areas (coastal areas)

South Carolina Natural Resources Information System

76. The South Carolina Natural Resources Information System (SCNRIS) was developed by the University of South Carolina Computer Service Division and continues to operate within the framework of the University.

77. Data in the SCNRIS are stored in both polygon and gridded format, but polygon data must be converted to a grid cell format for processing. Data are referenced to the Universal Transverse Mercator grid system.

78. The following types of data are in the system.

a. Vegetative land cover

b. Land use

c. Elevation

d. Slope and aspect

e. Transportation

f. Powerline corridors

g. Census data

Texas Natural Resources Information System

79. The Texas Natural Resources Information System (TNRIS) evolved from the Texas Water Development Board, created by the Texas Legislature in 1967 for the purpose of establishing a centralized data bank incorporating all hydrologic data collected by state agencies. In response to this, in 1968 representatives of eight agencies established a formal work group, the Water Oriented Data Programs Section, to provide coordination in forming the data bank. As the data bank grew, the participating agencies recognized that a broader, more comprehensive system including all natural resource data was needed and, in 1972, the TNRIS was established.

80. The development and operation of TNRIS is guided by a task force of 15 representatives from various state agencies and the governor's office. Staff and computer support is provided by the Texas Department of Water Resources. The system ties together the different information systems within the state and provides a central point of contact for information on data availability, procurement, and analysis to Federal, state, and local government entities, as well as requesters from the private sector and individual citizens. In addition to serving as a centralized point of contact, the

system has the capability to encode, store, retrieve, process, and analyze data.

81. The TNRIS has the capability to interface with a number of Federal systems, including the following:

a. U. S. Geological Survey
   (1) National Water Data Exchange (NAWDEX)
   (2) Water Data Storage and Retrieval System (WATSTORE)
   (3) National Cartographic Information Center (NCIC)
   (4) EROS Data Center

b. U. S. Environmental Protection Agency
   (1) Storage and Retrieval System (STORET)
   (2) STORET automatic mapping subsystem (AUTOMAP)

c. U. S. Department of Commerce
   (1) National Technical Information Service (NTIS)
   (2) Bureau of Census
   (3) National Oceanic and Atmospheric Administration - National Weather Service (NOAA-NWS)

d. U. S. Department of Agriculture - Federal Assistance Program

e. Water Resource Council - Water Resources Scientific Information Center (WRSIC)

82. The TNRIS provides access to more than 400 major natural resources and related data files, both automated and nonautomated. A key feature of all data files accepted by TNRIS is that a "responsible entity" is listed for each file. The responsible entity for a file can best explain any conditions or qualifications bearing upon use of the file. The TNRIS publication, File Description Report, contains brief descriptions of each file in the system.

83. Data files within TNRIS are classified in one of the following categories/subcategories:

a. Base Data

b. Meteorological Resources
   (1) climatological
   (2) air quality
   (3) man's activities

c. Biological Resources
   (1) animal
   (2) plant

(3) micro-organisms

(4) man's activities

d. Water Resources

(1) surface

(2) subsurface

(3) man's activities

e. Geological and Land Resources

(1) surface

(2) subsurface

(3) man's activities

f. Socioeconomic Resources

(1) social

(2) economic

(3) commerce

(4) government

(5) archaeologic

84. A Geographic Information System (GIS) is one of the many analytical tools for handling TNRIS data. Geographic information is normally stored in a polygonal structure to maintain maximum detail of source information; however, the system can also process data in grid-cell format. GIS data can be referenced to any one of eight different geographic coordinate systems at any scale.

85. Some of the operational capabilities and services of TNRIS include (a) computer-printed reports; (b) graphic outputs; (c) interface with remote terminals; (d) statistical packages; (e) computer-generated microfilm; (f) geocoding/geographic information handling; (g) analysis of remotely sensed data; (h) catalogues/indexes; (i) responses to inquiries concerning the availability of computerized data, aerial photography, satellite imagery/data, cartographic products, and technical publication; and (j) ordering services.

Utah Automated Geographic Reference System

86. The Utah Automated Geographic Reference (AGR) System was initially installed in June 1981. The system is housed in the Department of Natural Resources. At the present time, the only data in the system have been for demonstration and training purposes; however, by 1985, statewide topograhic and public land survey data will be in the system.

87. The system has the capability to use several coordinate systems for data referencing; however, the most commonly used are the Universal Transverse Mercator system and latitude/longitude. Data can be stored in either gridded or polygon format. The system allows data display ranging from printed tabular reports through pen plots on paper or mylar to elaborate color transparencies for photographic printing.

88. Users of the system will be charged for services depending on the amount of computer time and personnel time needed to produce the required information.

Virginia Commonwealth Data Base

89. The Virginia Commonwealth Data Base (CDB), housed in the Office of Commerce and Resources, has been operational since 1982. The CDB serves as the coordinator for two information systems in Virginia. Geographic information is maintained at Virginia Polytechnic Institute (VPI) while the ecometric data are maintained by the Virginia Institute of Marine Science at William and Mary College.

90. The CDB also maintains an inventory of other databases that contain information about the state. A manual prepared by the CDB, Data Systems Catalog, contains descriptions of all the individual databases.

91. Data are stored in both gridded and polygon formats. The Universal Transverse Mercator (UTM) grid system, state planar coordinate system, or latitude/longitude can be used to geographically reference data.

92. Statewide data in the system at VPI are referenced by the UTM grid system in 333 m × 333 m (27-acre) cells. The following statewide data are available.

a. Elevation
b. Slope
c. Aspect
d. Landform
e. Cover
f. Airports (occurrence)
g. Airports (obstruction clearance zones)
h. Warm springs (thermal activity)
i. Tornadoes

j. Geomagnetism

k. Langleys of solar radiation

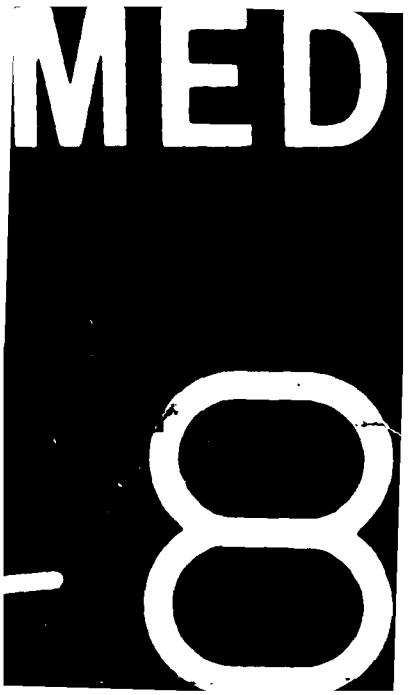
l. County boundaries

m. Planning district boundaries

n. Kuchler natural vegetation group boundaries

o. Soil associations

p. Historic sites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